

The Evolving Flow of Jupiter's White Ovals and Adjacent Cyclones

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We present results regarding the dynamical meteorology of Jupiter's White Ovals at different points in their evolution. Starting from the era with three White Ovals FA, BC, and DE (Galileo), continuing to the post-merger epoch with only one Oval BA (Cassini), and finally to Oval BA's current reddened state (New Horizons), we demonstrate that the dynamics of their flow have similarly evolved along with their appearance. In the Galileo epoch, Oval DE had an elliptical shape with peak zonal wind speeds of ~ 90 m/s in both its northern and southern peripheries. During the post-merger epoch, Oval BA's shape was more triangular and less elliptical than Oval DE; in addition to widening in the north-south direction, its northern periphery was 20 m/s slower, and its southern periphery was 20 m/s faster than Oval DE's flow during the Galileo era. Finally, in the New Horizons era, the reddened Oval BA had evolved back to a classical elliptical form. The northern periphery of Oval BA increased in speed by 20 m/s from Cassini to New Horizons, ending up at a speed nearly identical to that of the northern periphery of Oval DE during Galileo. However, the peak speeds along the southern rim of the newly formed Oval BA were consistently faster than the corresponding speeds in Oval DE, and they increased still further between Cassini and New Horizons, ending up at ~ 140 to 150 m/s. Relative vorticity maps of Oval BA reveal a cyclonic ring surrounding its outer periphery, similar to the ring present around the Great Red Spot. The cyclonic ring around Oval BA in 2007 appears to be moderately stronger than observed in 1997 and 2001, suggesting that this may be associated with the coloration of the vortex. The strengthening of the winds in Oval BA, the appearance of red aerosols, and the appearance of a turbulent, cyclonic feature to Oval BA's northwest create a strong resemblance with the Great Red Spot from both a dynamical and morphological perspective.

In addition to the White Ovals, we also measure the winds within two compact cyclonic regions, one in the Galileo data set and one in the Cassini data set. In the images, these cyclonic features appear turbulent and filamentary, but our wind field reveals that the flow manifests as a coherent high-speed collar surrounding relatively quiescent interiors. Our relative vorticity maps show that the vorticity likewise concentrates in a collar near the outermost periphery, unlike the White Ovals which have peak relative vorticity magnitudes near the center of the vortex. The cyclones contain several localized bright regions consistent with the characteristics of thunderstorms identified in other studies. Although less studied than their anticyclonic cousins, these cyclones may offer crucial insights into the planet's cloud-level energetics and dynamical meteorology.